MO 25: Interatomic and intermolecular Coulombic decay (contributed for SYCD in A, MO)

Time: Thursday 14:00–15:30 Location: B 302

Invited Talk MO 25.1 Thu 14:00 B 302

Interatomic Coulombic decay following electronic excitations — •Kirill Gokhberg — Physikalisch-Chemisches Institut, Heidelberg University, Germany

Ultrafast non-radiative decay of excited electronic states embedded into an environment by interatomic Coulombic decay or ICD mechanism has been a topic of extensive theoretical and experimental work. An interesting and comparatively unexplored area of the ICD research is the role of an environment in the decay of resonantly excited atoms and molecules. Theoretical calculations show that the ICD lifetimes of such states range from a few hundred to a few tens femtoseconds. These large ICD rates imply that the excited state dynamics observed in isolated system will be drastically modified by the environment. We illustrate this on examples of molecular photodissociation, and multiple ionisation of rare gas clusters in strong fields.

MO 25.2 Thu 14:30 B 302

The role of the partner atom and resonant excitation energy in ICD in rare gas dimers — •Patrick O'Keeffe[1], Paola Bolognesi[1], Marcello Coreno[1], Enrico Ripani[1], Lorenzo Avaldi[1], Michele Devetta[2], Robert Richter[3], Michele Di Fraia[3], Carlo Callegari[3], Kevin Prince[3], Antti Kivimaki[4], and Michele Alagia[4] — [1]CNR-IMIP, Area della Ricerca di Roma 1, Italy — [2]Dipartimento di Fisica, Università degli Studi di Milano, Milan, Italy — [3]Sincrotrone Trieste, Area Science Park, 34149 Trieste, Italy — [4]CNR-IOM, 34149 Trieste, Italy

This work shows experimental evidence for Interatomic Coulombic Decay (ICD) in mixed rare gas dimers following resonant Auger decay. A modified velocity map imaging apparatus together with a cooled supersonic beam containing Ar_2, ArNe and ArKr dimers was used to record electron VMI images in coincidence with either one or two mass selected ions following excitation of the species on five resonances converging to the Ar^+ $2p_{1/2}^{-1}$ and $2p_{3/2}^{-1}$ thresholds using the synchrotron radiation of Elettra. The results show that the kinetic energy distribution of the ICD electrons observed in coincidence with the ions from Coulomb explosion of the dimers depends on the partner ion and resonant excitation photon energy.

MO 25.3 Thu 14:45 B 302

Competition of ICD pathways in mixed neon-argon clusters — •Marko Förstel and Uwe Hergenhahn — Max-Planck-Institut für Plasmaphysik, c/o HZB-Bessy II, Albert-Einstein Str. 15, 12489 Berlin

Interatomic (or -molecular) coulombic decay (ICD) is an electronic de-excitation mediated by an energy transfer to the surrounding of the initially excited site.

Ne 2s excited, mixed Ne-Ar clusters exhibit both, Ne-Ar and Ne-Ne ICD. We measured both decay pathways simultaneously in mixed clusters of varying size and composition using electron-electron coincidence spectroscopy.

The decay rate of ICD is strongly dependent on the number and the distance to the neighbors of the initially excited atom. Additionally, the kinetic energy of the ICD electron allows for a direct assignment of the ICD pathway. Consequentially the structure of the mixed cluster can be probed by measuring the competition of Ne-Ne and Ne-Ar ICD.

I will present outer valence and inner valence spectra of Ne-Ar clusters of different sizes and composition. I will present electron-electron coincidence spectra of the same species. Both results will be used to discuss the composition and the structure of the clusters.

MO 25.4 Thu 15:00 B 302

Investigation of ICD via fluorescence spectroscopy — •Andreas Hans[1], André Knie[1], Benjamin Kambs[1], Daniel Metz[2], Jörg Voigtsberger[2], Florian Trinter[2], Till Jahnke[2], Reinhard Dörner[2], and Arno Ehresmann[1] — [1]Institut für Physik and Center for Interdisciplinary Nanostructure Science and Technology, Universität Kassel, Heinrich-Plett-Straße 40, D-34132 Kassel, Germany — [2]Institut für Kernphysik, Goethe-Universität Frankfurt am Main, Max-von-Laue-Straße 1, D-60438 Frankfurt, Germany

Interatomic Coulombic Decay (ICD) has recently been subject of many experiments. It is a new decay path for excited atoms in weakly bound systems. Here we introduce fluorescence as an as yet not considered tool to investigate ICD. In noble gas clusters fluorescence decay paths should be observable due to ICD, that are not possible in the atomic case. A more elegant possibility offer mixed clusters. After excitation of one kind of atom fluorescence of the cluster partner can be measured. We introduce the planned spectroscopy experiments to proof and investigate the ICD-process and we present results of preliminary experiments on fluorescence spectroscopy of noble gas atoms and clusters.

MO 25.5 Thu 15:15 B 302

Interatomic Coulombic Electron Capture in Double Quantum Dots — •Federico M. Pont, Annika Bande, Kirill Gokhberg, and Lorenz S. Cederbaum — Theoretische Chemie, Physikalisch-Chemisches Institut, Im Neuenheimer Feld 229, 69120 Heidelberg, Germany

We demonstrate that Interatomic Coulombic Electron Capture (ICEC) is possible in double quantum dots. It was first proposed for atomic dimers and is a process were one electron is captured by one of the atoms and the released energy is used to ionize the neighboring atom. ICEC is related to the Inter Coulombic Decay (ICD) processes, and it can be conceptualized using a virtual photon mechanism as well, but it is not a resonant process. The model used consists of two aligned dots separated by a distance R in a quasi-onedimensional nanowire. We are interested in a regime where the dots are not identical, they have only one bound state each, and the separation R is long enough to prevent electrons from tunneling between them. Since ICEC is not a resonant process, it can be in principle accessible in a wide range of energies. However we have found that in the quasi-onedimensional regime, the process shows enhancements for some definite values of the incoming electron momentum. In this case the reaction probability for ICEC was estimated to be of the order of 1%. Another ICEC related process was analyzed by allowing one of the dots to have one more bound state. In this setup a delocalized resonance between dots, which can decay through ICD, aids the process and a huge increase in the reaction probability is found reaching values up to 35%.